absorption is remarkable, and apparently cannot be explained by the colour of the glass.

No. 8 is of 60°; its μ for E=1·620. It is free from colour, and an evident improvement on the earlier ones.

No. 9, a prism of 90°, was given to the author by Dr. Lloyd for a small mirror in the Newtonian form of the Armagh 15-inch reflector; its μ for E=1·6188.

No. 10, of 90°, was obtained by the late Lord Rosse to be similarly used in his 3-feet Newtonian; its μ for E=1·5321.

No. 11, of 60°, obtained at Munich in 1837. For these measures the ends were polished flat; its μ for E=1·6405.

These three show considerable progress, and an object-glass made of such materials would have a great power of transmission, though much behind the following.

No. 12 is of 90°. Its glass is from Chance; its μ for E=1·6216.

No. 13 is a cylinder 2·2 inches in diameter, and 4·3 long, which Mr. Grubb obtained from Messrs. Chance for these measures; its μ for E = 1·5200.

No. 14 is a cylinder got at the same time, 2·1 inches in diameter and 4·4 long; its μ for E = 1·6126; the ends of both are polished flat, and they are of wonderful transparency.

If, as there is good ground for hoping, Messrs. Chance shall succeed in manufacturing large disks of the same perfection as these two cylinders, the author's comparison of the achromatic and the reflector must be considerably modified.

Assuming n=·02, he calculates that the aperture of an achromatic, of focal length equal to 18 times the aperture, equivalent to a 4-feet Newtonian, is 35·435 inches. This aperture would be diminished if the process of cementing were found applicable to lenses of such magnitude.

The author concludes with suggesting that, as very slight variations in the manufacture of glass seem to make great changes in its absorptive power, it would be prudent to examine the value of n in the disks intended for lenses of any importance. This could be done by polishing a couple of facets on their edges, and need not involve the sacrifice of many minutes.

II. "Note on the Formation and Phenomena of Clouds." By John Tyndall, LL.D., F.R.S. Received January 25, 1869.

It is well known that when a receiver filled with ordinary undried air is exhausted, a cloudiness, due to the precipitation of the aqueous vapour diffused in the air, is produced by the first few strokes of the pump. It is, as might be expected, possible to produce clouds in this way with the vapours of other liquids than water.

In the course of the experiments on the chemical action of light which have been already communicated in abstract to the Royal Society, I had frequent occasion to observe the precipitation of such clouds in the experimental tubes employed; indeed several days at a time have been devoted

solely to the generation and examination of clouds formed by the sudden dilatation of the air in the experimental tubes.

The clouds were generated in two ways: one mode consisted in opening the passage between the filled experimental tube and the air-pump, and then simply dilating the air by working the pump. In the other, the experimental tube was connected with a vessel of suitable size, the passage between which and the experimental tube could be closed by a stopcock. This vessel was first exhausted; on turning the cock the air rushed from the experimental tube into the vessel, the precipitation of a cloud within the tube being a consequence of the transfer. Instead of a special vessel, the cylinders of the air-pump itself were usually employed for this purpose.

It was found possible, by shutting off the residue of air and vapour after each act of precipitation, and again exhausting the cylinders of the pump, to obtain with some substances, and without refilling the experimental tube, fifteen or twenty clouds in succession.

The clouds thus precipitated differed from each other in luminous energy, some shedding forth a mild white light, others flashing out with sudden and surprising brilliancy. This difference of action is, of course, to be referred to the different reflective energies of the particles of the clouds, which were produced by substances of very different refractive indices.

Different clouds, moreover, possess very different degrees of stability; some melt away rapidly, while others linger for minutes in the experimental tube, resting upon its bottom as they dissolve like a heap of snow. The particles of other clouds are trailed through the experimental tube as if they were moving through a viscous medium.

Nothing can exceed the splendour of the diffraction-phenomena exhibited by some of these clouds; the colours are best seen by looking along the experimental tube from a point above it, the face being turned towards the source of illumination. The differential motions introduced by friction against the interior surface of the tube often cause the colours to arrange themselves in distinct layers.

The difference in texture exhibited by different clouds caused me to look a little more closely than I had previously done into the mechanism of cloud-formation. A certain expansion is necessary to bring down the cloud; the moment before precipitation the mass of cooling air and vapour may be regarded as divided into a number of polyhedra, the particles along the bounding surfaces of which move in opposite directions when precipitation actually sets in. Every cloud-particle has consumed a polyhedron of vapour in its formation; and it is manifest that the size of the particle must depend, not only on the size of the vapour polyhedron, but also on the relation of the density of the vapour to that of its liquid. If the vapour were light, and the liquid heavy, other things being equal, the cloud-particle would be smaller than if the vapour were heavy and the liquid light. There would evidently be more shrinkage in the one case than in the other: these considerations were found valid througohut the

experiments; the case of toluol may be taken as representative of a great number of others. The specific gravity of this liquid is 0·85, that of water being unity; the specific gravity of its vapour is 3·26, that of aqueous vapour being 0·6. Now, as the size of the cloud-particle is directly proportional to the specific gravity of the vapour, and inversely proportional to the specific gravity of the liquid, an easy calculation proves that, assuming the size of the vapour polyhedra in both cases to be the same, the size of the particle of toluol cloud must be more than six times that of the particle of aqueous cloud. It is probably impossible to test this question with numerical accuracy; but the comparative coarseness of the toluol cloud is strikingly manifest to the naked eye. The case is, as I have said, representative.

In fact, aqueous vapour is without a parallel in these particulars; it is not only the lightest of all vapours, in the common acceptation of that term, but the lightest of all gases except hydrogen and ammonia. To this circumstance the soft and tender beauty of the clouds of our atmosphere is mainly to be ascribed.

The *sphericity* of the cloud-particles may be immediately inferred from their deportment under the luminous beams. The light which they shed when spherical is *continuous*: but clouds may also be precipitated in solid flakes; and then the incessant sparkling of the cloud shows that its particles are *plates*, and not spheres. Some portions of the same cloud may be composed of spherical particles, others of flakes, the difference being at once manifested through the *calmness* of the one portion of the cloud, and the *uneasiness* of the other. The sparkling of such flakes reminded me of the plates of mica in the River Rhone at its entrance into the lake of Geneva, when shone upon by a strong sun.

III. "On the Behaviour of Thermometers in a Vacuum." By BENJAMIN LOEWY, F.R.A.S. Communicated by Prof. STOKES, Sec. R.S. Received January 8, 1869.

1. In the year 1828 General Sabine made a series of pendulum-experiments* in a receiver from which the air was exhausted, and observed incidentally that on the pump being worked the thermometer in the receiver fell about 7-tenths of a degree of Fahrenheit's scale when the pressure was reduced to 7 inches, while the converse took place when the air was readmitted. He ascribed this effect to the removal of the pressure of the atmosphere on the exterior of the bulb and tube of the thermometer; and to ascertain whether this explanation was correct the following experiment was made:—A thermometer being immersed in pounded ice and placed on the brass plate of an air-pump, the mercury coincided exactly with the division of 32°; it was then covered with a receiver, and the air withdrawn; the thermometer fell as the pump was worked, and when the

* Published in the Philosophical Transactions, 1829, part 1.